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ABSTRACT

Three readability formulas were applied to chapters from six textbooks to determine (1) if there was a significant difference in readability of three consecutive textbook editions of a seventh grade and of an eighth grade text over a 12-year period (1968-1980), and (2) whether eighth grade students would perform equally to the same content from a current and from a 1968 edition of the text. The texts involved were from the Harcourt, Brace, Jovanovich Science series for the seventh and eighth grades. The three readability formulas used to determine the grade level of each text were the Dale-Chall Formula, the Fry Formula, and SMOG Grading. After the three readability formulas were applied to the six texts, 17 eighth grade students were asked to read equivalent chapters in the 1968 and 1980 editions of the eighth grade text. The results showed that text readability dropped over the 12-year span, and that students performed significantly better on the current, lower readability level text. (HOD)

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THE DUMBING DOWN OF TEXTBOOKS:

An Analysis of Six Textbook Editions During a Twelve Year Span.

by

JEANNE JAREMA GIONFRIDDO

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ABSTRACT

This experiment was based on the hypothesis that there is no significant difference in the readability of three consecutive textbook editions of a seventh and of an eighth grade text, or in the student's ability to comprehend equivalent material in the oldest and most recent editions.

After three different readability formulas were performed on the six texts, seventeen eighth grade students were employed to read equivalent chapters in the 1968 and 1980 editions of the eighth grade text.

The results of this study showed a drop in text readability over the twelve year span, and that students performed significantly better on the current, lower readability level text.

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This paper is dedicated to the memory of my father, Eugene D. Jarema, whose dream of my receiving a Masters Degree has now become a reality.

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Recent studies have given evidence that the readability level of current textbooks is actually lower than that of textbooks used in the past.

Johnson studied social studies textbooks from 1967 - 1976, and found, "The average reading levels of the texts published in 1976 were lower than those in 1967 and 1970." (Johnson, 1977)

This is not an isolated incident. Johnson goes on to say that by, "... comparing all the reading levels, it can be seen that there is now a trend toward lowering the reading levels (of textbooks)." (Johnson, 1977)

Teachers must be aware of what is happening to the texts, for an important factor in determining student success is their ability to understand the printed material. Unfortunately it would be difficult, if not impossible, to find a text which would be perfect for every child. The teacher would likely have to use several different texts. Spiegel and Wright confirm this by writing, "Matching each student to a text at the optimum level for success would be nearly impossible, yet students who are placed in texts that are too difficult for them often gain little information from their reading." (Spiegel and Wright, 1983) Therefore, lower level texts are used for everyone, even for those who wouldn't necessarily need them.

In relation to these facts, many ideas have been generated as to how the text selection can be made. Beldon and Lee report that it is necessary to determine the student's read-

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ing ability as well as text readability when making the selection. They found that, "... the reading achievement of the student must be one grade level above the reading difficulty of the book." (Beldon and Lee, 1962)

To determine reading difficulty, many readability formulas have been designed. The Dale - Chall Formula is based on average sentence length and the percentage of unfamiliar words contained in the material. (Words which are not contained on the Dale list of 3000 words are considered unfamiliar.) (Dale and Chall, 1948)

Another formula was designed by Edward Fry. This formula counts the number of words, sentences, and syllables in three separate 100 word passages, selected at random. The average score is calculated, and readability is determined by plotting this score on a graph. (Fry, 1968)

A third method, SMOG Grading, was developed by G. Harry McLaughlin. This procedure also includes the counting of sentences, but limits the syllable count to only those contained in polysyllabic words of three syllables or more. By adding the number of multi-syllable words and determining the square root, a readability level can be assigned. (McLaughlin, 1969)

These are but three of the many readability methods available. The differences shown in these representative samples are indicative of the various ways readability is determined. Therefore, when selecting a text, it is necessary to know which formula(s) the publisher used to arrive at the

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designated grade level. Wheeler and Sherman state that, "We may not be able to compare the results of one readability formula with another because the formulas use different criteria to measure readability." (Wheeler and Sherman, 1983)

Mills and Richardson suggest the need for a common formula. "It is our contention that every effort should be made to control at least the more mechanical, objective variables to get the selection of reading books and materials out of the realm of pure guesswork." (Mills and Richardson, 1963)

Much emphasis is placed on the scores determined by these readability formulas. However, these scores should only be considered as guideposts of actual reading difficulty. (Wheeler and Sherman, 1983)

Nancy Marshall has found that a major problem with readability formulas is that they do not measure meaning or the background experience of the reader. She states that, "Instead of determining the readability of textbooks, educators should be determining their comprehensibility." (Marshall, 1979) This is met with agreement by Shymansky and Yore who stated, "The reading requirements of all written materials used in a classroom should be considered for comprehensibility or meaningfulness for particular readers, and science textbooks are no exception." (Shymansky and Yore, 1979)

A checklist to determine this comprehensibility has been designed by Irwin and Davis. This allows the teacher to determine the strengths and weaknesses of available texts in

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terms of their understandability for her particular students. (Irwin and Davis, 1983) This can be an effective measure in helping educators find the best texts for their students.

Many studies have been conducted to determine the readability of content texts because of the problems which students are having in trying to read them. (Johnson, 1977)

As the studies continued to be reported, it became evident that the use of technical vocabulary was a contributing factor to the high readability levels assigned to science texts. These technical terms were considered unfamiliar as they did not appear on the Dale list. Also, these terms were often multi-syllabic and repeated several times, therefore helping to inflate the readability level.

Unfortunately, the repetition of technical terms seems to be counted against the text rather than in its favor. Cohen and Steinberg report that, "... repeated technical words add to reading comprehension because they are encountered again and again, increasing the probability of their becoming low information words." (Cohen and Steinberg, 1983) They continue by emphasizing that word repetition contributes to reading ease and that this continued use of the terms may make the readability of that text actually lower than the readability formulas indicate. (Cohen and Steinberg, 1983)

The use of technical vocabulary is important to the context of the material. However, practical use of these words is limited or deleted in an effort to lower text read-

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ability. Nancy Marshall cautions, however, that, "When sentences and vocabulary are oversimplified, cohesion is lost. As a result, comprehension becomes much more difficult because the reader must infer the missing information." She further states that, "Since some materials written for poor readers do not make the inferences necessary for comprehension to occur, simply written texts may be more difficult to understand than those with a higher readability level." (Marshall, 1979) Johnson supports this idea by pointing out that, "... lowering the readability level of a textbook does not necessarily make a text easier to understand." (Johnson, 1977)

Therefore, instead of lowering the readability of these texts, attention should be paid to instructing students to use their textbooks, and helping students raise their abilities.

The establishment of a minimum competency level for high school graduation is a step toward stabalizing the decline of educational standards. Jeanne S. Chall, a noted reading authority, has stated, "... competency testing might well become a constructive force for improving student achievement - if the tests are given early enough, if they are challenging enough, and if the results are used as guides for instruction." (Chall, 1979)

Early detection and prompt remediation of disabled readers will help to raise student achievement to acceptable standards. Perhaps then it will not be necessary to "dumb

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down" current texts to meet low student performance.

These issues are of great concern to our educational system. Standards and expectations need to be set, and teaching methods and materials need to gear students toward their highest potential.

The purpose of this study is to determine if there is a significant difference in readability of the same text during a 12 year period. This will be determined by using the Dale-Chall, Fry, and SMOG Grading Formulas. Also, there will be a determination if students perform differently on the same content from a current and a 1968 edition of the text, if the readabilities differ.

HYPOTHESIS

There is no significant difference in the readability of three consecutive textbook editions of two different content texts, or in the student's ability to comprehend material in the oldest and most recent editions of the same content.

ASSUMPTIONS AND LIMITATIONS

It will be assumed that students will be randomly grouped and the material selected from both textbook editions covers essentially the same material.

The limitations of this study include the fact that a small sample of seventeen eighth grade students will be participating. Also, the study is limited to three editions of a seventh grade science text and three editions of an

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eighth grade science text.

DELIMITATIONS

The delimitations of this study are that it will reflect a small sampling of seventeen eighth grade students in a small, white, middle class, suburban school. The conclusions of this research cannot be extended beyond the population sampled.

DEFINITIONS

readability - All the factors that affect success in reading and understanding a text. These factors include:

A. The interest and motivation of the reader.

B. The legibility of the print (and of any illustrations.)

C. The complexity of words and sentences in relation to the reading ability of the reader. (Johnson, 1979)

dumbing down - The effort to make text readability comply with the reading level of the student.

comprehensibility - The factors in a text which help it relate meaning to the reader.

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PROCEDURE

Appropriate data was initially collected from various educational journals. This information contained data on readability and comprehensibility.

Six textbooks were then chosen for the study. The texts involved were from the Harcourt, Brace, Jovanovich Science series for the seventh and eighth grades. Their titles are: Life, A Biological Science, (seventh grade) and Matter, An Earth Science, (eighth grade). Three editions from each grade were used, dating from 1968 - 1980.

Three readability formulas were used to determine the grade level of each text. These formulas were The Dale-Chall Formula, The Fry Formula, and SMOG Grading.

After choosing related content from the 1968 and 1980 editions of the eighth grade texts, the three readability formulas were applied to each chapter chosen. This was done to determine the specific readability of each chapter used in the study.

Two experiments were then conducted using a class of seventeen eighth grade students.

In both experiments, the class was first presented with background information on the concepts through lecture, discussion, and activities.

In experiment A, the class was randomly divided into two groups. A purpose for reading was set. The control group of nine students read the chapter as written in the 1980 edition. The experimental group of nine students read the equivalent

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chapter as written in the 1968 edition. Quiet classroom time was provided to complete the reading.

Immediately after reading, their comprehension of the material was tested by completing a published multiple choice test which had accompanied the appropriate edition.

In experiment B, the procedure was the same. However, the student assigned groups were reversed, and a different chapter was read.

RESULTS

As illustrated in Table 1, Matter, An Earth Science

TABLE 1

Readability Scores of Matter, An Earth Science (Eighth Grade Textbook)

	1968	1975	1980
Dale-Chall Formula	11-12th Grade	11-12th Grade	7-8th Grade
SMOG Grading	11th Grade	10th Grade	9th Grade
Fry Formula	9th Grade	9th Grade	7th Grade

showed a drop in readability over the years.

In 1968, the text, according to the Dale-Chall Formula, had a readability level of 11 - 12th grade, while the 1980 edition showed a 7 - 8th grade level. The Fry Formula showed a drop of two grade levels, finding the readability of the 1980 edition of the eighth grade text at grade 7. SMOG Grading also showed a two year drop in grade level. In 1968, the readability was determined to be 11th grade, while the 1980

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edition showed a 9th grade readability.

Although each formula is different in approach, and although one specific grade level was not unanimously assigned, each formula does show a significant two year drop in readability.

In assessing the readability levels of Life, A Biological Science, two of the three formulas agreed that the level of the 1980 text was lower than the 1968 edition. As shown on Table 2, the Fry Formula exposed a three year drop over that

TABLE 2

Readability Scores of Life, A Biological Science (Seventh Grade Textbook)

	1968	1975	1980
Dale-Chall Formula	9-10th Grade	9-10th Grade	9-10th Grade
SMOG Grading	12th Grade	10th Grade	9th Grade
Fry Formula	10th Grade	8th Grade	7th Grade

twelve year period between editions. The 1980 text had a readability of grade 7. SMOG Grading agreed that there was a three year drop in readability between the 1968 and 1980 editions of the seventh grade text. This formula, however, estimated the readability level of the 1980 edition to be grade 9. The Dale-Chall Formula showed no change. All editions were determined to be at the 9 - 10th grade level.

Student performance on the 1968 and 1980 editions was then tested.

The four chapters read were from Matter, An Earth

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Science, two from the 1968 edition, and two from the 1980 edition. One set of chapters was about minerals, and the other set was about atoms. All three readability formulas were performed on these four chapters.

As illustrated in Table 3, only the Fry Formula showed

TABLE 3

Readability Scores of Equivalent Chapters on Minerals in Matter, An Earth Science (Eighth Grade Textbook)

	1968	1980
Dale-Chall Formula	11-12th Grade	11-12th Grade
SMOG Grading	10th Grade	10th Grade
Fry Formula	8th Grade	7th Grade

a one year decline in the mineral chapter. The 1968 edition was assessed at grade 8, while the 1980 edition showed a readability of grade 7.

Table 4 shows that both SMOG Grading and the Fry Formula

TABLE 4

Readability Scores of Equivalent Chapters on Atoms in Matter, An Earth Science (Eighth Grade Textbook)

	1968	1980
Dale-Chall Formula	11-12th Grade	11-12th Grade
SMOG Grading	12th Grade	10th Grade
Fry Formula	8th Grade	7th Grade

showed a significant drop in readability in the atoms chapter. SMOG Grading showed a two year drop in readability, with

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the 1980 edition's level now at grade 10. The Fry Formula showed a one year drop to grade 7 for the 1980 edition of the eighth grade text.

A group of seventeen eighth grade students were randomly divided into two groups. As shown in Table 5, there was no

TABLE 5

Mean, Standard Deviation, and t of Grade Equivalent Scores of Group A* vs. Group B* on the California Achievement Test.

	Mean	Standard Deviation	t
Group A	11.3	1.89	.66
Group B	11.0	1.90	
No Significance			

* A random sample of 9 eighth grade students
* A random sample of 8 eighth grade students

significant difference in the reading scores of these groups at the onset of this study.

While the experimental group read a chapter in the 1968 edition, the control group read the equivalent chapter in the 1980 edition. In a second session, the experiment was repeated, but the student assigned groups were reversed. Prior to their reading, lecture and discussion on the information occurred. After reading a chapter, students completed the 20 question multiple choice test, provided by the publisher, which had accompanied the appropriate edition. Students were given an unlimited amount of time to complete the reading and the multiple choice test.

As illustrated in Table 6, the mean score of the ni...

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TABLE 6

Mean, Standard Deviation, and t of Group A*

	Mean	Standard Deviation	t
Mineral Chapter 1968 Text	7.5	3.66	5.66
Atoms Chapter 1980 Text	10.5	3.31	
Significant .01			

* A random sample of 9 eighth grade students

students in group A rose from a 7.5 correct on the 1968 test to 10.5 correct on the 1980 test. This was significant below .01.

As illustrated in Table 7, the mean score of the 8

TABLE 7

Mean, Standard Deviation, and t of Group B*

	Mean	Standard Deviation	t
Atoms Chapter 1968 Text	9.33	3.71	4.00
Mineral Chapter 1980 Text	11.62	2.77	
Significant .01			

students in group B rose from 9.33 correct on the 1968 test, to 11.62 correct on the 1980 test. This was also significant below .01.

It can therefore be said that the students performed significantly better on the current text with the lower readability.

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It should also be noted that, according to Table 8, the

TABLE 8

Mean, Standard Deviation, and t of the Performance of Group A vs. Group B on the 1968 Text.

	Mean	Standard Deviation	t
Group A	7.5	3.66	2.66
Group B	9.33	3.71	
Significant .01			

students who read the 1968 edition's chapter on atoms, Group B, performed significantly better than the students who read the 1968 edition's chapter on minerals. However, as illustrated in Table 9, there was no significant difference in the

TABLE 9

Mean, Standard Deviation, and t of the Performance of Group A vs. Group B on the 1980 Text.

	Mean	Standard Deviation	t
Group A	10.5	3.31	1.29
Group B	11.62	2.77	
No Significance			

student's performance after reading the chapters in the 1980 edition.

CONCLUSIONS

This study was based on the question: Is there a significant difference in the readability of the same text during a twelve year period, and will students perform equally to the same content from a current and a 1968 edition,

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if the readabilities differ?

The results of this study indicate that the seventh and eighth grade texts, Life, A Biological Science and Matter, An Earth Science, have dropped in readability levels since 1968, and students can perform significantly better on a multiple choice test after reading a chapter in the most current text, one which has a lower readability level than the equivalent chapter in an older, higher readability edition.

While reviewing the readability levels of the six texts studied, it is obvious that the 1968 edition showed a readability far above the grade level of the student for whom it was intended. The initial intent of lowering the readability level may therefore have been a valid one. However, the readability levels of the 1980 texts still do not correctly match the grade levels, and in two cases, fall below the eighth grade level for which they were written.

Since, in this study, the current text showed a lower readability level than that of a previous year and the study partially confirms the belief that many current texts have low readabilities, one must wonder how long this trend can be allowed to continue. Is it beneficial to lower educational standards and expectations? Is this lower standard a contributing factor to poor student performance on older, higher readability texts? Is the high degree of poor performance among college freshmen on basic skills tests a result of such "dumbing down"? Revisions are required so that readabilities at least match the grade level for which they were written.

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Indeed, there has been a trend toward "dumbing down" our textbooks.

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The Dumbing Down of Textbooks:

Related Literature

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Edward Fry, a noted readability specialist, considers, "Matching the level of the student with the level of the material," as the basic idea of readability. (Fry, 1975) This match, however, can be complicated by several problems, such as motivation of the reader. Fry continues, "High motivation overcomes high readability levels, while low motivation demands low readability levels." (Fry, 1975) A student, for example, with a ninth grade reading level may read and understand technical information on car mechanics or electricity written on the twelth grade level if he is highly interested in the subject and is motivated to concentrate on it. On the other hand, a student with a low reading and motivation level may not be as likely to concentrate on the material. Therefore, Fry states, "... make the reading easy for him until either his reading ability improves or his motivation for reading something increases." (Fry, 1975) R. K. Johnson agrees with this by stating, "The prose in a school book usually should be much simpler than the readers are capable of reading." (R. K. Johnson, 1979)

Many studies have been done on the readability of textbooks and their influence on the reader.

In 1950, Mallinson, Sturm, and Patton had reviewed 15 textbooks, five in each of grades four, five, and six. A total of 75 readability samples were determined by the Flesch Formula. They concluded that the texts they studied were far too difficult for the average student in grade four, rather difficult for the average student in grade five, and

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slightly difficult for the average student in grade six. Mallinson, Sturm, and Patton had stated, "None (of these texts) can be construed as easy reading material." (Mallinson, et al, 1950)

Cohen and Steinberg attribute the jump in readability between a fourth and fifth grade text (equivalent to slightly over one grade level) to a 57% increase of technical vocabulary in a fifth grade science text. Their study, completed in 1983, reviewed nine science texts in grades four through six for a total of 313 samples. They not only determined readability, according to the Dale - Chall Formula, but judged the appearance of technical words, words which provided technical support, and nontechnical words. They found that while an average of 14.7 words were familiar according to the Dale list, 10.5 were technical, 3 were nontechnical, and 1.5 were technical support. The appearance of these technical words raised the readability scores. However, consideration must be given to the fact that these technical words were often repeated within the sample. For example, the word atom, considered as unfamiliar, appeared 19 times, and was therefore counted as 19 unfamiliar words. Cohen and Steinberg concluded, "... if technical words have a high frequency, then the readability levels generated by the Dale-Chall Formula overinflate the difficulty levels." (Cohen and Steinberg, 1983)

A similar study in readability levels had been conducted by Beldon and Lee in 1962. Their emphasis, however, was

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placed on high school texts, and determined readability for selected secondary natural science texts. This level was compared to the achievement level in reading of the students enrolled. The results showed that the four eleventh grade Chemistry texts which they had reviewed, had a readability range of 12.0 through 13.0 and therefore only provided useful reading material to 34-47% of the students. They also studied five twelfth grade Physics texts and found a readability range of 9.8 through 12.1. These provided useful reading material for 62-90% of the students. (Beldon and Lee, 1962)

The controversy over text difficulty continued, and was not confined to the area of science. Johnson studied three consecutive editions of elementary school social studies texts between 1967 and 1976. He had determined the readability of forty-one 1967 texts, grades one through six, using the Spache Formula (grades one through three) and the Dale - Chall Formula (grades four through six). Together with Varidan, the readability levels of sixty-eight 1970 editions were determined in the same way. This data led to the conclusion that the average reading level of social studies textbooks was increasing. Johnson continued his study by evaluating the readability levels of 16 texts published in 1976. His conclusion now states, "The average reading levels of texts published in 1976 were lower than those published in 1967 and 1970." He further stated, "By comparing all the reading levels, it can be seen that there is now a trend

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toward lowering the reading levels (of textbooks)." (Johnson, 1977)

The intent of lowering the readability of texts was to make them more comprehensible to the reader. Johnson supports this by remarking, "It appears that the publishers of elementary social studies texts are finally going to at least try to give the students a chance to read the text and hopefully comprehend the material." (Johnson, 1977)

If that was the intent, unfortunately research shows that it is not always the case.

Bonnie Armbruster, of the University of Illinois Center for the Study of Reading, has just completed a study in which adults were asked to read 20 paragraphs from several sixth grade texts, and underline or state the main idea. This, however, resulted in failure for the adults due to the disjointed, dumbed down content. (Bowen, 1984)

Perhaps the reason for such disjointed content was the conscious effort to lower readability. Although the intent may have been to make the texts easier, actually the opposite may be true. Nancy Marshall explains that when lowering text readability, "Publishers shorten sentences and eliminate some of the technical vocabulary. This results in some vaguely defined concepts and a disjointed string of simple sentences. The book with the lower readability level is no longer written as connected discourse." (Marshall, 1979)

Jeanne Chall recently completed a study in which the readability levels of texts in grades 1, 8, and 11 were

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compared with the results of the standardized test scores of the students who had used them. A direct correlation between the decline in text readability and the decline in SAT scores was determined. (Bowen, 1984)

Such information has led to a series of studies in comprehensibility versus readability.

Duffy and Kabance completed an extensive study on factors which affect comprehension, in 1982. The study was done in three parts and found 230 Navy recruits, aged 17-20, reading a series of passages.

The first study involved reading two passages, the original and a revised edition with a lower readability level. They determined that, "Simplifying complex sentences produced the greatest improvement in readability score, but the vocabulary simplification is what produced the positive though trivial performance effects. Even this effect is lost, however, when the sentences are over simplified." (Duffy and Kabance, 1982)

In their second study, Duffy and Kabance had the subjects read the passages and then complete an exercise using the cloze procedure as a measurement of comprehension. The use of the cloze procedure has been praised by Shymansky and Yore, who stated,"The cloze procedure appears to be a valid indicator of readability since it actually gives a measure of the reader's interaction with the printed materials." (Shymansky and Yore, 1979) Duffy and Kabance found through this study that, "It would seem that under most conditions,

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revising materials by simplifying vocabulary and sentences is not an effective way of improving comprehension, at least when the reader is not required to organize and store the text." (Duffy and Kabance, 1982)

The third study required the subjects to read the passages and answer comprehension questions at the end. This meant that the subjects had to use their memory of the material, for to achieve success on the questions, they had to process all the information in the passage. The results of this study are given in two parts. The performance of the subjects who fell into the category of high ability students showed a slight decrease in comprehension when sentences were simplified, yet the simplification of vocabulary had no negative effects. For the low ability readers, on the other hand, "... vocabulary manipulation resulted in the smallest change in readability, but had the largest effect on their comprehension." (Duffy and Kabance, 1982) In conclusion, the simplification of vocabulary may aid comprehension, while the simplification of sentences may hinder it.

Great care must be issued when preparing a revision of material so it is actually more comprehensible for the reader. Fry cautions, "... readability formulas are meant to be used after the material is written, not as a writer's guide." (Fry, 1975)

A study on text revision has recently been completed by Beck, McKeown, Omanson, and Pople. They began by revising a second and a third grade story by identifying the problems in

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the original and correcting them. They categorized the problem areas according to three classifications. Surface problems were difficulties in words and phrases, events and states. Problems in the nature of the content were established by determining how much background experience was necessary to understand the content. Specific problems were those such as confusing referents, missing events, lack of a cause or effect, and a confusing purpose. Once the revisions were completed, 48 third grade students were employed to read either the original or revised version. They concluded that, "... children who read the revised editions did recall more of the stories and correctly answered more of the questions than did the children receiving the commercial stories, although the effect was marginally reliable for the questions." (Beck, et al, 1984) An interesting point as a result of these revisions shows their effect on readability, according to the Fry Formula. Story A increased from 811 to 957 words, and jumped from a third grade readability level to a fourth grade readability level. Story B increased from 782 to 900 words, and jumped from a second grade to a third grade readability level. (Beck, et al, 1984) It appears that the revisions were more comprehensible for the students, although the readability formula indicated they increased in difficulty. This emphasizes the need to produce coherent, comprehensible texts.

Eberwein states that readability is only one of the many things to be considered when selecting material for a text. Story content and interest, vocabulary, author's style, and

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the relationship of the story to the specific skill being taught should also be considered. (Eberwein, 1979) R. K. Johnson adds that consideration should also be given to printing quality, complex sentence structure, and too much material containing entirely new ideas. (R. K. Johnson, 1979) But, Shymansky and Yore caution that although, "... technical vocabulary, content loading, and the use of symbols, graphics, directions, and if-then statements make science reading skills more difficult, they are critical to overall student success." (Shymansky and Yore, 1979)

Yet, according to Mallinson, Sturm, and Mallinson, this, "... reading difficulty may be partially responsible for the inability of these pupils to comprehend easily the concepts and topics of science presented to them." (Mallinson, et al, 1950) Therefore, it seems necessary to improve the student's reading ability to use these skills, rather than try to lower the text's readability and possibly lose its comprehensibility.

This is not to say that readability is not important. Fry states, "We need to recognize that readability determination is not precise, but that does not mean that readability isn't an important concept. Furthermore, the determination and awareness of readability is a professional tool that should be in every teacher's bag of tools." (Fry, 1975)

Newport states that the readability level, "... should be of considerable importance in selecting a series for classroom use." (Newport, 1965) Eberwein states that information

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on readability would benefit teachers and "... help them ... plan for instruction and give students suggestions on how to make adjustments for the difficulty level of the material read." (Eberwein, 1979)

In a recent study conducted by Spiegel and Wright, 622 high school biology teachers were surveyed as to their ideas on readability. The results of the questionaire revealed the following:

1. High school science teachers want a variety of texts on different readability levels to meet student needs.

2. Authors should account for concept depth and load, concrete examples, and affective concerns such as sentence length, etc.

3. Readability in a text should be varied according to content difficulty.

4. Administrators should listen to teacher's intuitiveness as to student needs. (Spiegel and Wright, 1983)

Much emphasis has been placed on readability formulas and their implications on instruction. However, great care should be taken when using these formulas. According to Mallinson, Sturm, and Mallinson, "... a satisfactory average may conceal many difficult sections (in a text)." (Mallinson, et al, 1957) Also, attempts to lower texts toward a specific readability level have not always led to student success. Vaughan concludes that, "A readability score is only an estimate of the difficulty of a reading passage; no discrete

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score can be considered definitive." (Vaughan, 1976)

It is important that texts should be both readable and comprehensible. For, as stated by Mallinson, Sturm, and Mallinson, "... a book is not likely to be of much value to students if they cannot read it with sufficient ease to understand it." (Mallinson, et al, 1957)

Therefore, when writing texts, caution should be exercised to see that vocabulary is explained, content is developed, and the relationship between sentences is coherent. If this reflects a higher readability score, perhaps then it is time to raise the student's reading ability by teaching reading skills in the content areas, rather than to dumb down the textbooks and create a multitude of unnecessary problems.

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APPENDICES

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TABLE 10

The California Achievement Test Grade Equivalent Scores of the seventeen eighth grade students used in this study.

Group A	Group B
12.9	12.9
12.9	12.9
12.9	12.5
12.9	12.2
12.2	11.3
10.5	9.1
10.5	8.8
8.6	8.6
8.3	

TABLE 11

The multiple choice test scores of Group A

1968 edition (minerals)	1980 edition (atoms)
12	17
12	11
10	6
9	13
9	12
6	12
6	10
6	9
5	9

TABLE 12

The multiple choice test scores of Group B

1968 edition (atoms)	1980 edition (minerals)
17	18
13	10
10	12
10	10
8	9
7	12
7	11
5	11

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